

Accuracy Characteristics for Final Delivery Scenario Hours 1200-1700 Interfacility

1 Introduction

This document contains scenario characteristics for hours 1200 to 1700 GMT recorded on May 26, 1999 at Memphis ARTCC and cover either the ZME or ZID airspace. Characteristics to be provided are general statistics determined from the scenario on airspace characteristics, aircraft to aircraft and aircraft to airspace encounters, general air traffic, aircraft, flight plan adherence, interfacility traffic flow and deviations in weather forecasts. Definitions of the provided scenario characteristics are provided in Reference[1].

2 Reference

[1] Paglione,M., Oaks,R., Ryan,Dr. H., Summerill,J.S., (Final, January 2000), *Description of Accuracy Scenarios for the Acceptance Testing of the User Request Evaluation Tool (URET) / Core Capability Limited Deployment (CCLD)*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

NOTE – Section numbers in this document do not map to those of the reference document.

3 Center Airspace

This section corresponds to Section 3.1 of Reference[1]. The below data corresponds to the ZME Center using the May 20, 1999 ACES chart cycle. Information gathered from running URET PRE, accessing the ZME Center Internet site and local knowledge.

Metric	Definitions	Count
Center Area	Approximate Square Miles	120000
Airports	From URET DU Adaptation List	778
Sectors	From URET DU Adaptation List	110
SAA	Special Activities Airspace	57
APDIA	Automated Problem Detection Inhibited Area	20
SID	Standard Instrument Departure	11
STAR	Standard Arrival Route	10
PAR	Preferential Arrival Route	594
PDR	Preferential Departure Route	346
PDAR	Preferential Departure Arrival Route	124

4 Aircraft Encounter Distributions

The statistics collected in this section characterize aircraft to aircraft encounters. The encounter counts are partitioned by selected minimum horizontal separation intervals, a count of encounters partitioned by standard flight levels, and by vertical phase of flight and aircraft encounter angle. This section corresponds to Section 3.2.1 in Reference[1].

4.1 Count Partitioned by Minimum Horizontal Separation

This section corresponds to Section 3.2.1.1 in Reference[1].

Table 1: Count of Current Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	13 Minutes Adherence
$0 \leq d < 5$	157	110
$5 \leq d < 10$	200	116
$10 \leq d < 15$	245	136
$15 \leq d < 23$	462	279
$23 \leq d < 30$	397	247
Total	1461	888

Table 2: Count of Trial Plan Aircraft Encounters

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
$0 \leq d < 5$	157	106
$5 \leq d < 10$	200	106
$10 \leq d < 15$	245	126
$15 \leq d < 24$	527	300
$24 \leq d < 30$	332	206
Total	1461	844

4.2 Count Partitioned by Altitude for Standard Separation Intervals

This section corresponds to Section 3.2.1.2 of Reference[1].

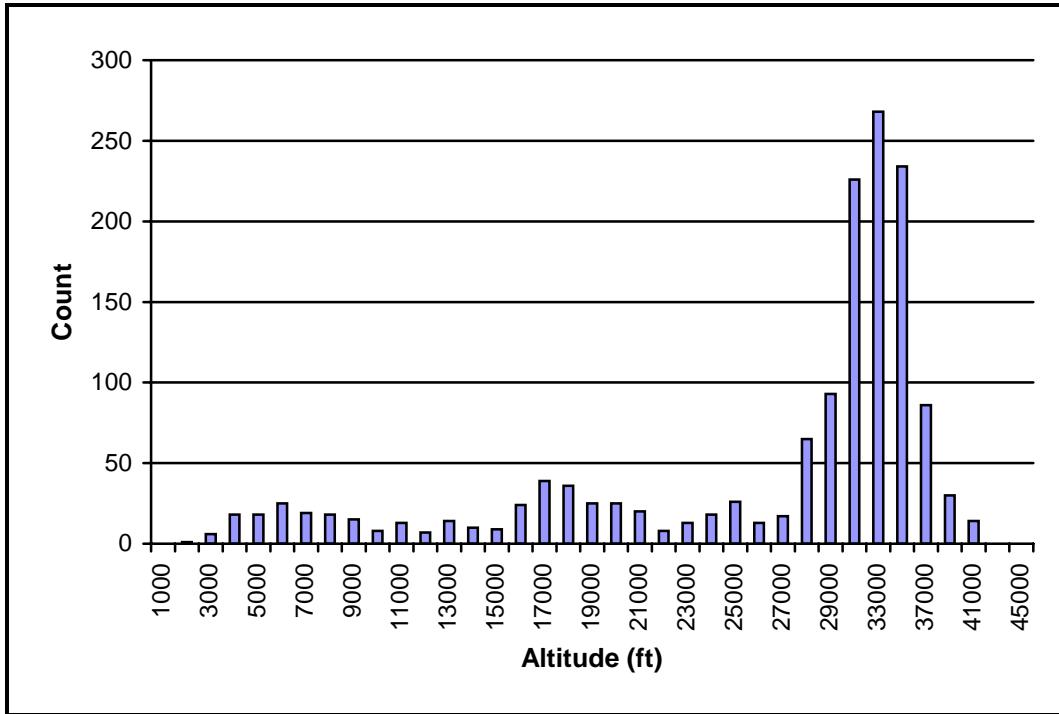


Figure 1: Aircraft to Aircraft Encounters by Altitude

4.3 Count Partitioned by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.1.3 of Reference[1].

Table 3: Count of Aircraft Encounters Partitioned by Phase of Flight and Encounter Angle

Vertical Phase	Encounter Angles (deg)				Total
	[0, 45)	[45, 90)	[90, 135)	[135, 180]	
Cruise-Cruise	118	106	70	37	331
Descend-Descend	36	14	7	11	68
Climb-Climb	43	11	9	11	74
Cruise-Climb	138	84	83	114	419
Cruise-Descend	132	105	86	113	436
Climb-Descend	38	15	25	40	118
Unknown	10	1	2	2	15
Total	515	336	282	328	1461

5 Airspace Encounter Distributions

This section provides statistics on aircraft to airspace encounters. Three areas considered are counts partitioned by selected minimum horizontal separation intervals, an encounter count partitioned by standard flight levels, and a count partitioned by vertical phase of flight and airspace encounter angle. Additionally, vertical phase of flight count is separated into top, bottom and side airspace encounters and for encounters with unknown encounter angles. The section corresponds to Section 3.2.2 of Reference[1].

5.1 Count Partitioned by Minimum Horizontal Separation

The section corresponds to Section 3.2.2.1 of Reference[1].

Table 4: Count of Current Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	13 minutes Adherence
Conflicts ¹	2260	1951
$d = 0^2$	37	30
$0 < d < 7$	776	613
$7 \leq d < 9$	218	165
$9 \leq d < 11$	175	144
$11 \leq d < 16$	517	406
$16 \leq d < 30$	1828	1434
Total	5811	4743

Table 5: Count of Trial Plan Airspace Encounters by Horizontal Separation

Min. Horz. Separation (nm)	Without Adherence	20 minutes Adherence
Conflicts ³	2260	1912
$d = 0^4$	37	30
$0 < d < 8$	889	686
$8 \leq d < 11$	280	220
$11 \leq d < 13$	182	138
$13 \leq d < 19$	717	559
$19 \leq d < 30$	1446	1107
Total	5811	4652

¹ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

² This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

³ This count includes encounters that are conflicts. By definition the minimum horizontal separation is zero and the track point actually penetrates the airspace.

⁴ This count includes encounters without valid airspace penetrations, which occurs under two cases: a short duration penetration or an encounter on the actual buffered boundary of the airspace which does not penetrate.

5.2 Count Partitioned by Altitude

This section corresponds to Section 3.2.2.2 of Reference[1].

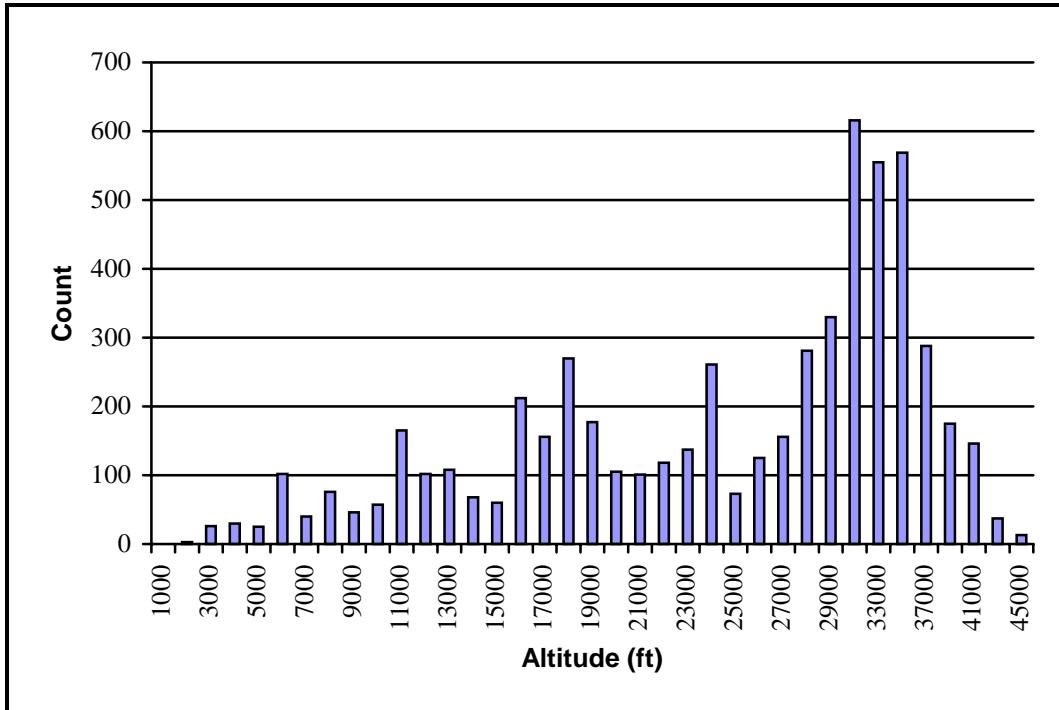


Figure 2: Airspace to Airspace Encounters by Altitude

5.3 Count by Vertical Phase of Flight and Encounter Angle

This section corresponds to Section 3.2.2.3 in Reference[1].

Table 6: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Side Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	17	75	114	206
Cruise	117	611	713	1441
Descend	22	59	68	149
Total	156	745	895	1796

Table 7: Count of Airspace Encounters by Angle and Vertical Phase of Flight for Top and Bottom Conflicts

Vertical Phase	Encounter Angles (deg)			Total
	[0, 30)	[30, 60)	[60, 90)	
Climb	169	0	0	169
Cruise	0	0	0	0
Descend	18	0	0	18
Total	187	0	0	187

Table 8: Count of Airspace Encounters by Vertical Phase of Flight with Unknown Angles

Vertical Phase	Count
Climb	56
Cruise	186
Descend	35
Total	277

6 Air Traffic Distributions

This section provides metrics that characterize the air traffic. The metrics are flight density partitioned by standard flight levels, flight type and sector penetration, statistics on the number of active flights, ground speed statistics, counts of interim altitude and amendment messages, and air traffic maneuvers by altitude and phase of flight. This section corresponds to Section 3.3 of Reference[1].

6.1 Air Traffic Density

This section corresponds to section 3.3.1 of Reference[1]. Detailed statistics on aircraft encounters are provided in Appendix A.

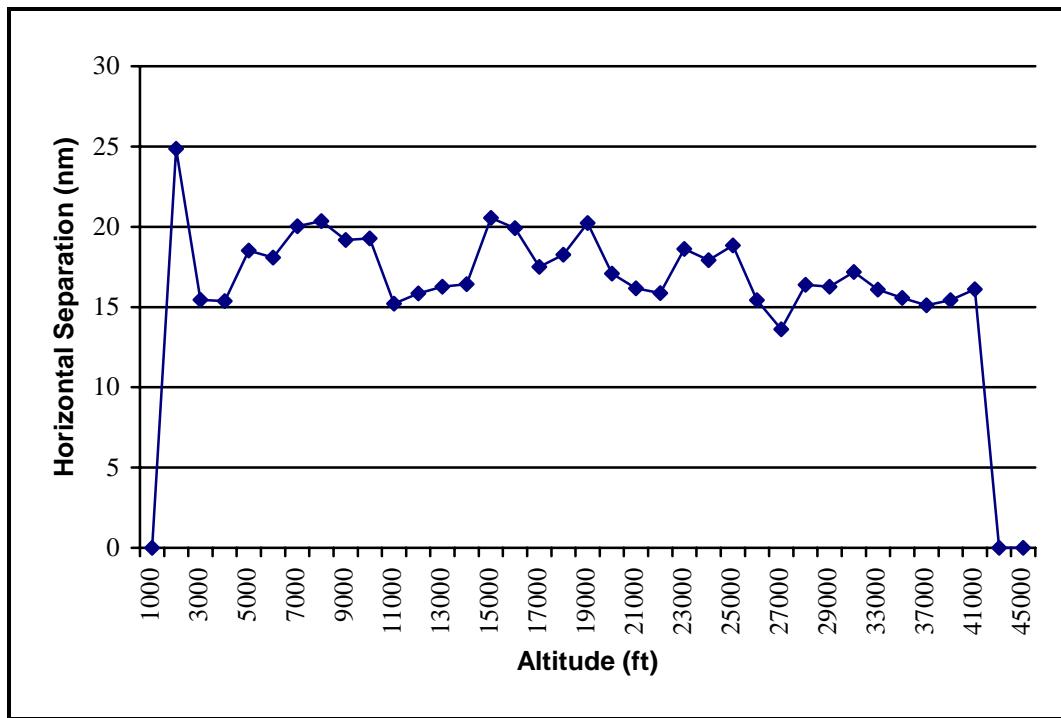


Figure 3: Average Horizontal Separation by Altitude for All Hours

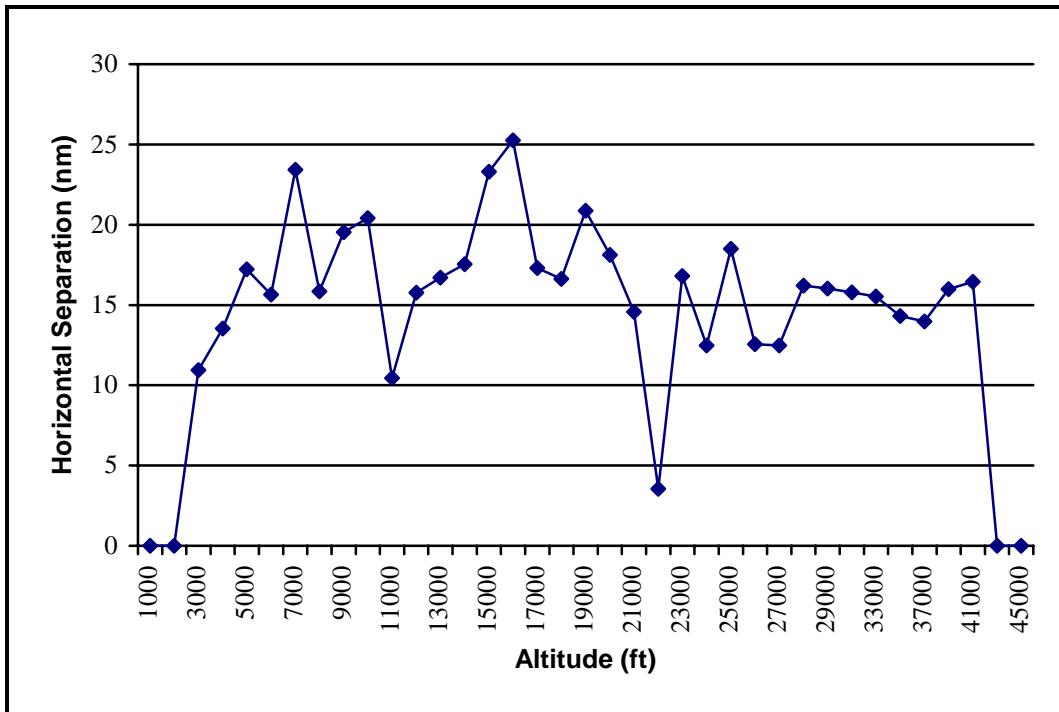


Figure 4: Average Horizontal Separation by Altitude for Hour 1

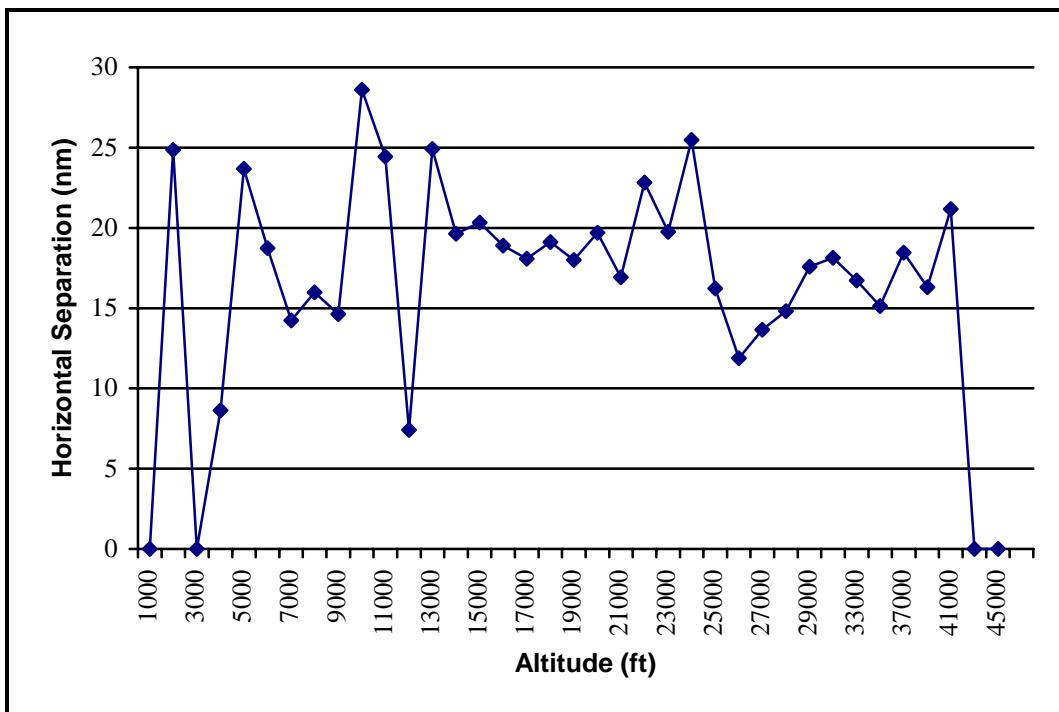


Figure 5: Average Horizontal Separation by Altitude for Hour 2

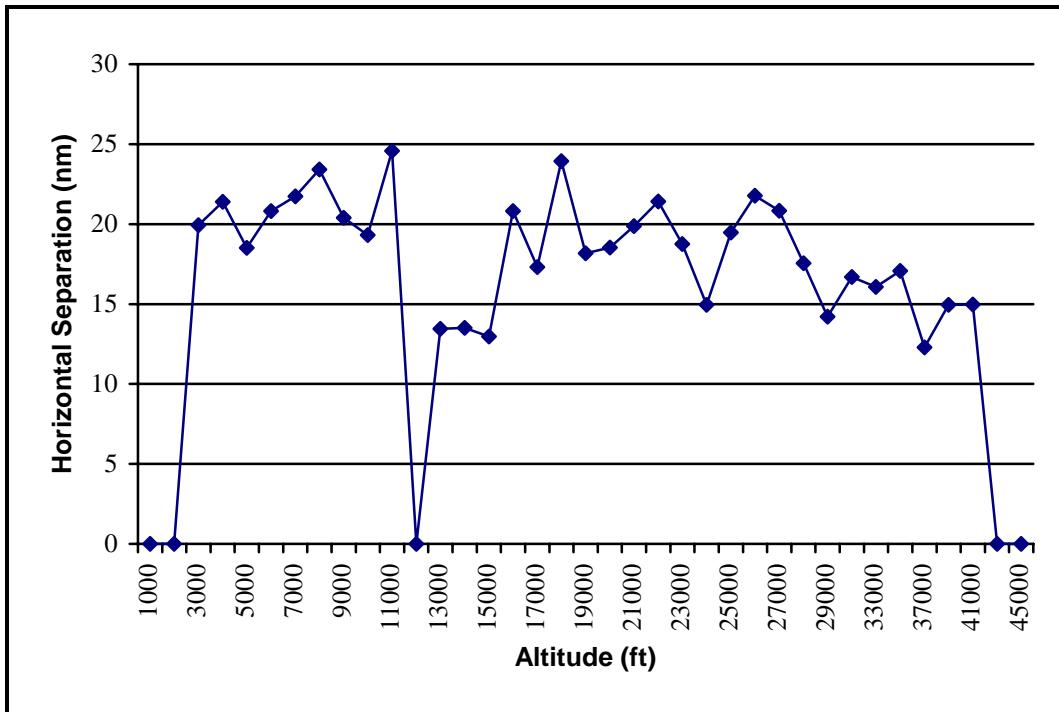


Figure 6: Average Horizontal Separation by Altitude for Hour 3

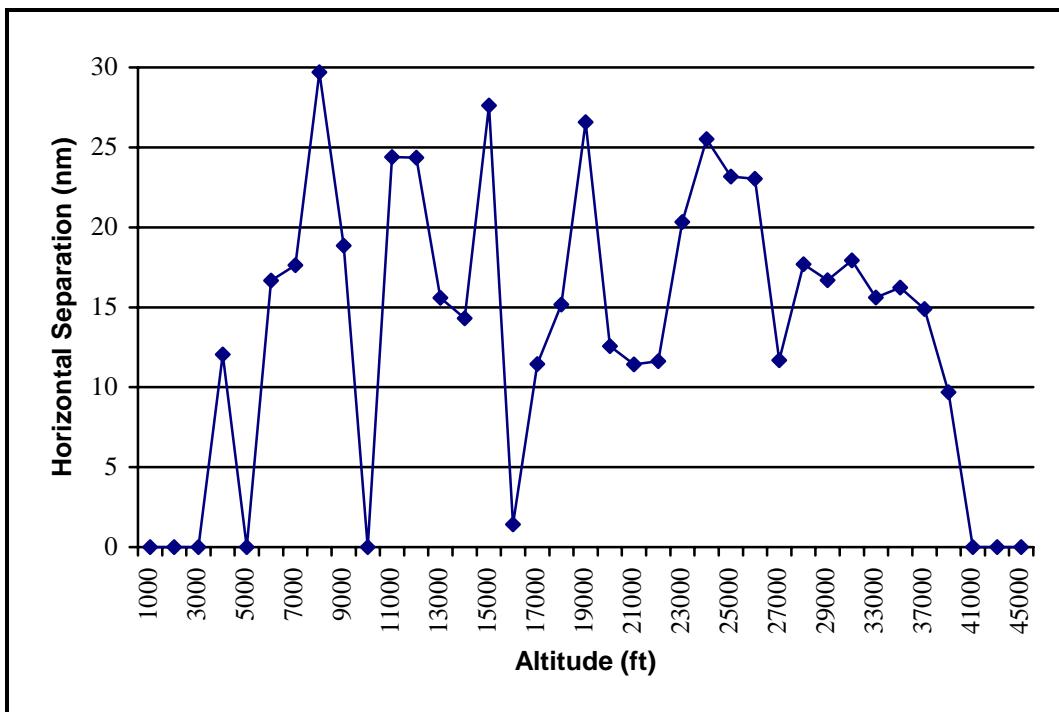


Figure 7: Average Horizontal Separation by Altitude for Hour 4

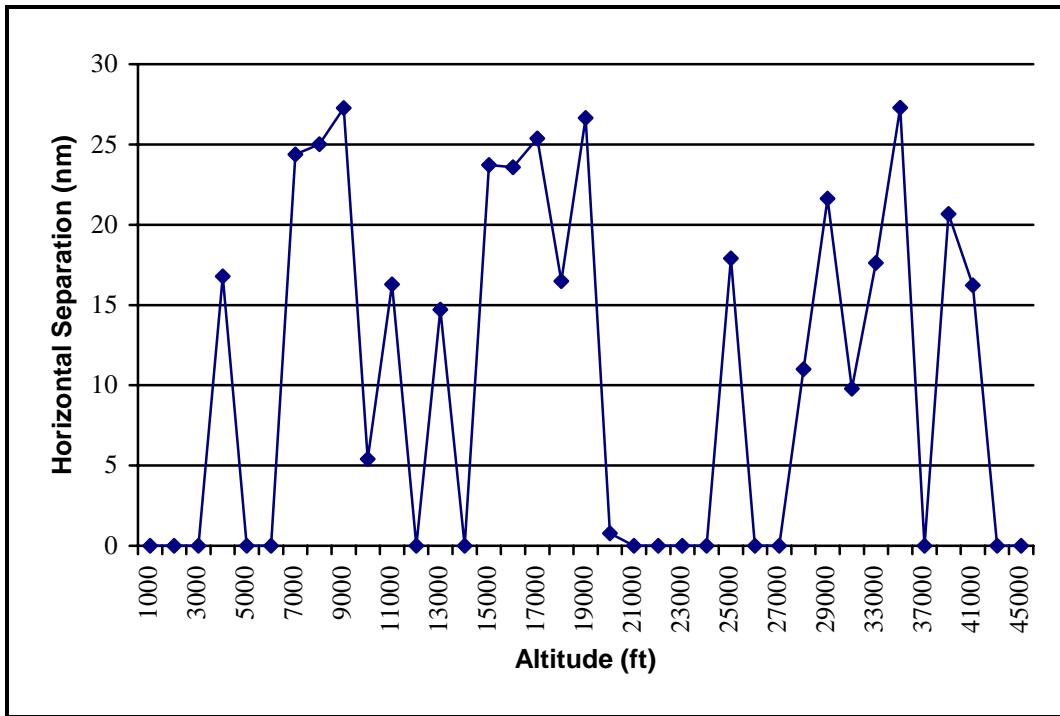


Figure 8: Average Horizontal Separation by Altitude for Hour 5

6.2 Active Flights

This section corresponds to section 3.3.2 of Reference[1].

Table 9: Statistics on Active Flights per Minute Increment

Count Average	Standard Deviation	Maximum Count	Minimum Count
179.570	77.941	273	0

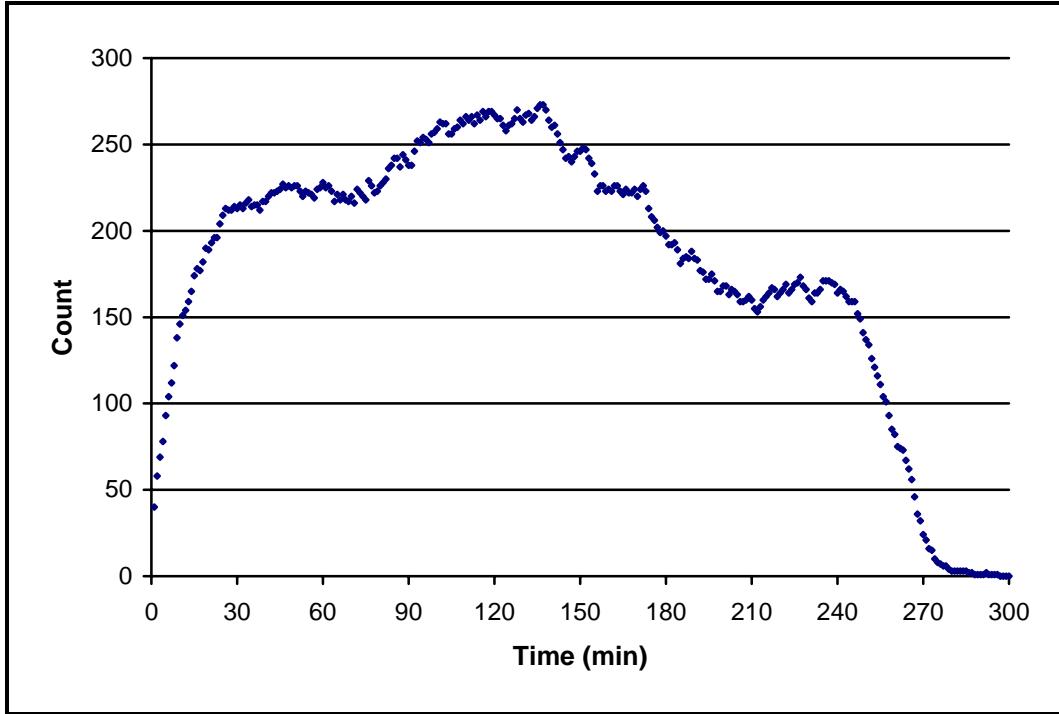


Figure 9: Count of Active Flights per Minute Increment

6.3 Flight Type and Sector Penetration

This section corresponds to Section 3.3.3 of Reference[1].

Table 10: Statistics on Sector Time, Center Time and Sector Penetration by Flight Type

Metric	Arrivals	Departures	Internals	Overflights	All Flights
Average Number of Sectors Penetrated	1.942	2.223	2.074	2.450	2.259
Average Time in Center (sec)	1278.585	1245.763	1573.056	1746.201	1514.777
Average Time in Sector (sec)	640.238	543.914	712.411	702.856	655.018
Percentage by Flight Type	21.600	23.600	7.200	47.600	100.000

6.4 Ground Speed

This section corresponds to Section 3.3.4 of Reference[1]. Detailed statistics on aircraft ground speed are provided in Appendix B.

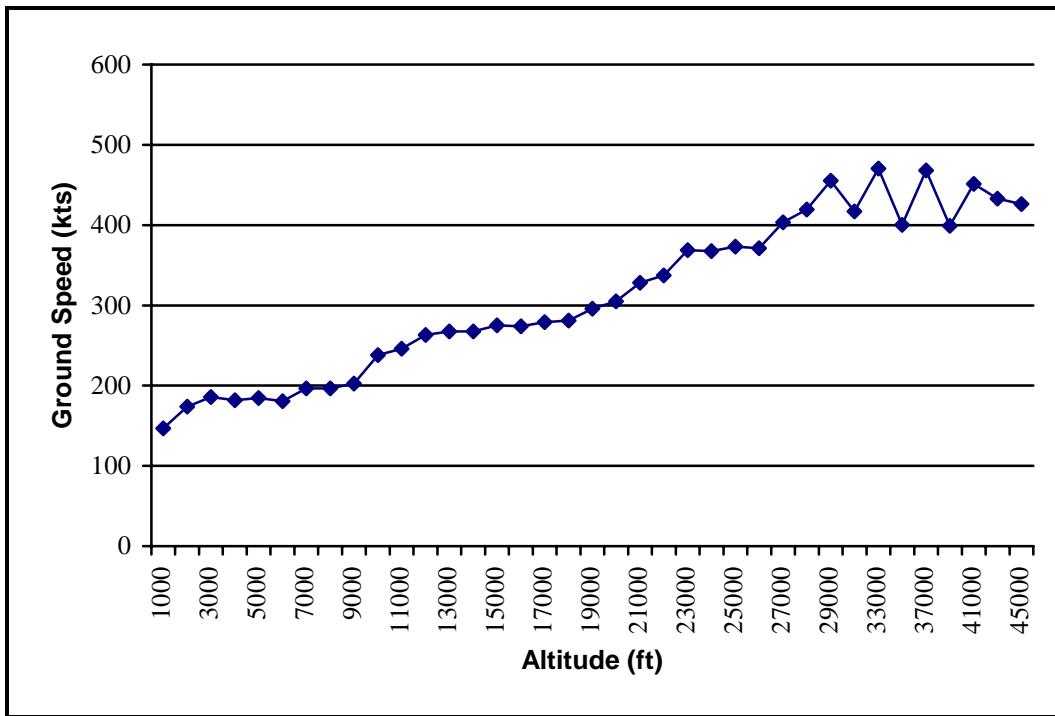


Figure 10: Average Ground Speed by Altitude for All Hours

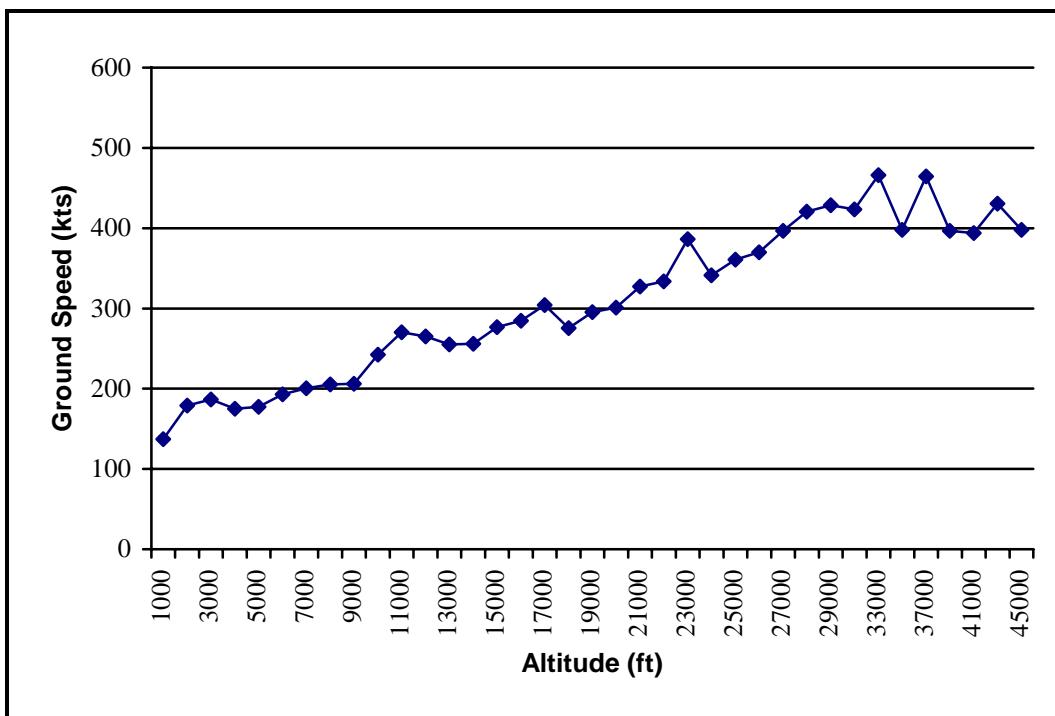


Figure 11: Average Ground Speed by Altitude for Hour 1

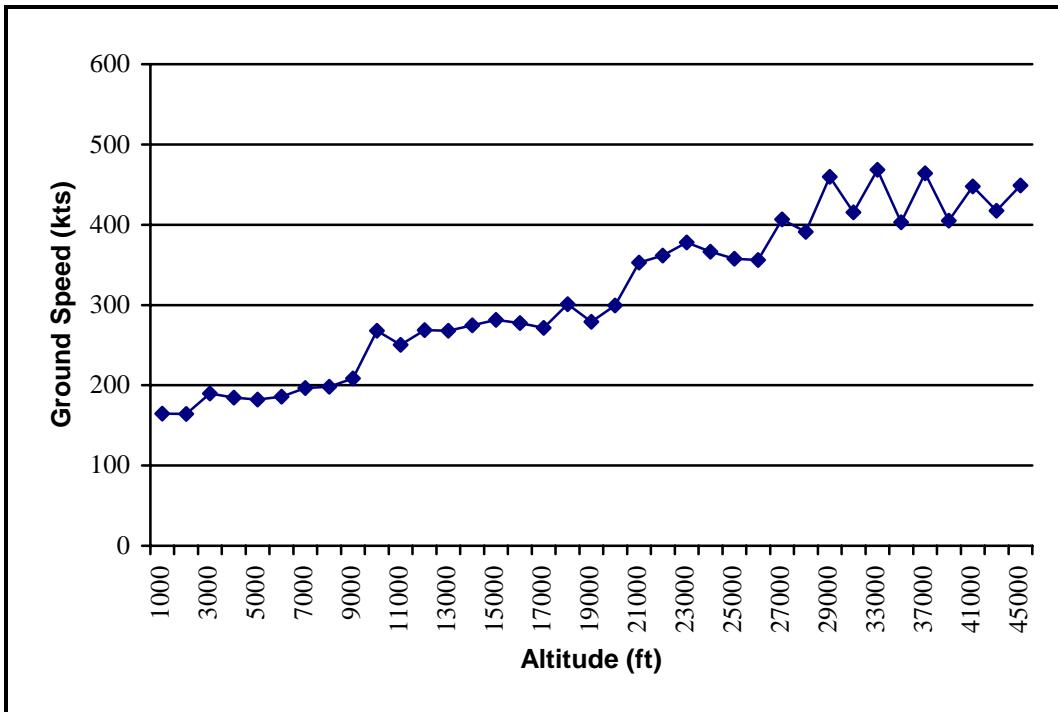


Figure 12: Average Ground Speed by Altitude for Hour 2

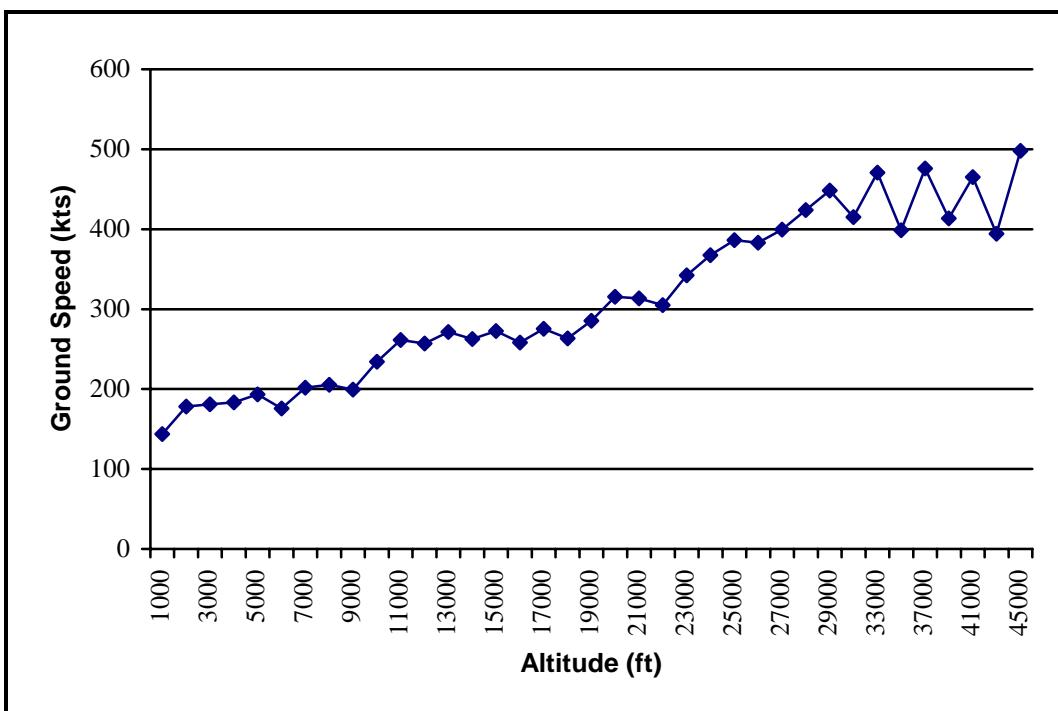


Figure 13: Average Ground Speed by Altitude for Hour 3

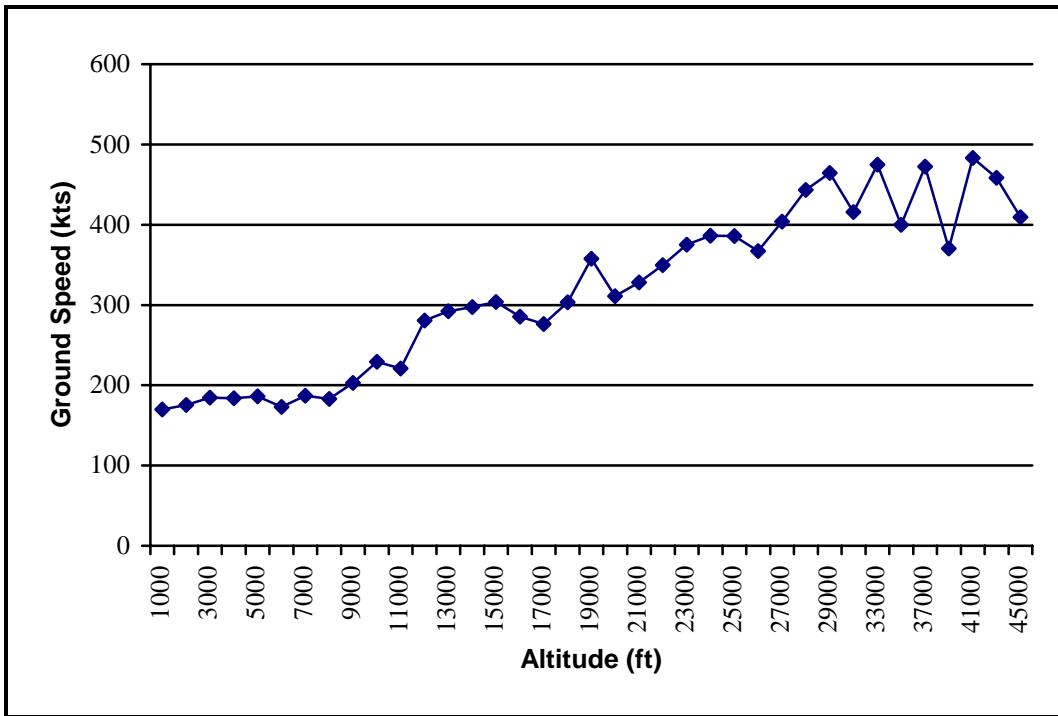


Figure 14: Average Ground Speed by Altitude for Hour 4

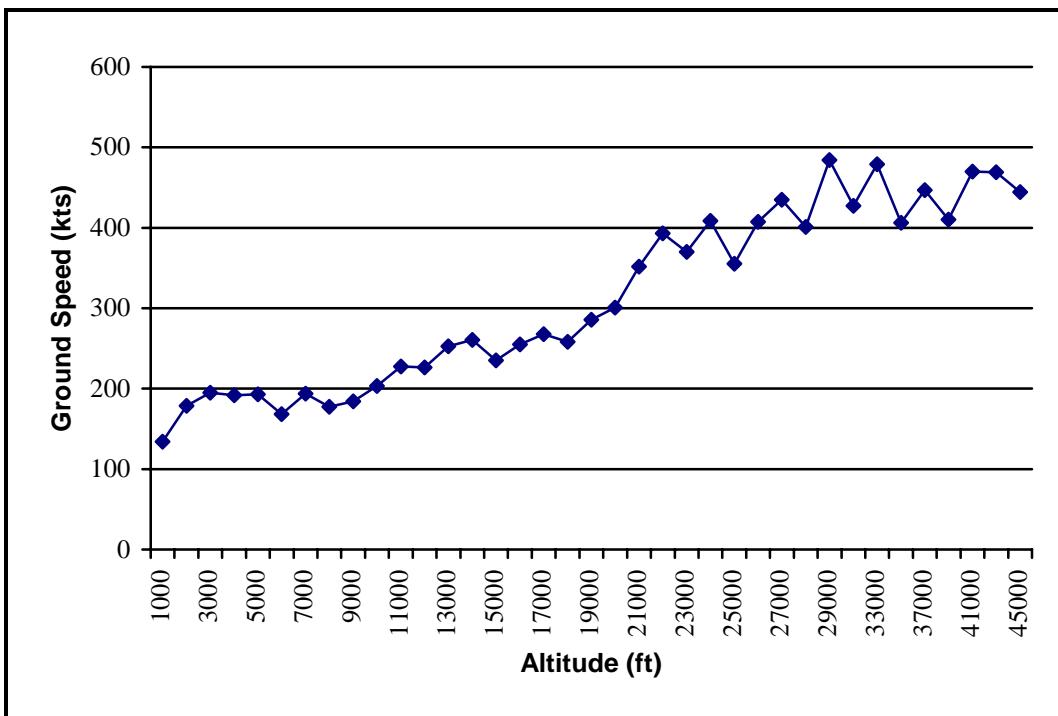


Figure 15: Average Ground Speed by Altitude for Hour 5

6.5 Center to APD Ratio

This section corresponds to Section 3.3.5 of Reference[1].

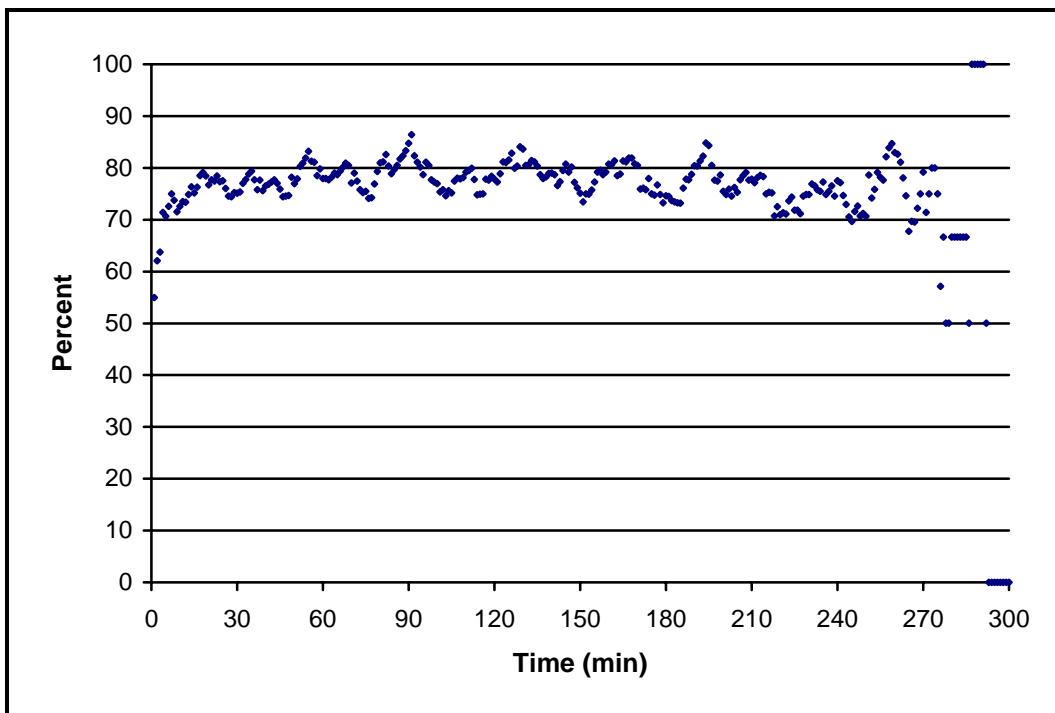


Figure 16: Percentage of Track Points in Center to APD Zone per Minute Increment

6.6 Interim Altitude Messages

This section corresponds to Section 3.3.6 of Reference[1].

Table 11: Statistics on Interim Altitude Messages⁵

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
1011	2.894	1.220	8	1

6.7 Amendment Messages

This section corresponds to Section 3.3.7 of Reference[1]

Table 12: Statistics on Amendment Messages per Flight⁶

Flight Count	Average	Standard Deviation	Maximum Count	Minimum Count
795	1.971	1.291	9	1

⁵ Statistics on flights with interim altitude messages only

⁶ Statistics on flights with flight plan amendments only

6.8 Air Traffic Maneuvers

This section corresponds to Section 3.3.8 of Reference[1]. Detailed statistics on air traffic maneuvers are provided in Appendix C.

Table 13: Total Track Report Maneuver Count by Vertical and Horizontal Phase of Flight

Vertical Phase	Horizontal Phase of Flight		Total
	STR	TURN	
ASC	8399	1804	10203
DES	9090	1791	10881
LEV	3248	1927	5175
Total	20737	5522	26259

Table 14: Percent breakdown of Flight Tracks by Vertical and Horizontal Phase

Vertical Phase	Horizontal Phase of Flight		Margin (%)
	STR (%)	TURN (%)	
ASC	31.985	6.870	38.855
DES	34.617	6.821	41.437
LEV	12.369	7.338	19.708
Margin (%)	78.971	21.029	100.000

7 Aircraft Distributions

This section provides the metrics used to characterize the aircraft provided in the scenario. The selected metrics are aircraft type, model, navigational equipment, and the air carriers operating in the airspace. The section corresponds to Section 3.4 of Reference[1].

7.1 Aircraft Type

This section corresponds to Section 3.4.1 of Reference[1].

Table 15: Count by Aircraft Type

Aircraft Type	Count	Percentage of Total
J	1031	68.098
P	201	13.276
T	280	18.494
Unknown	2	0.132
Total	1514	100.000

7.2 Aircraft Models

This section corresponds to Section 3.4.2 of Reference[1]. A full listing and count of aircraft models is provided in Appendix D.

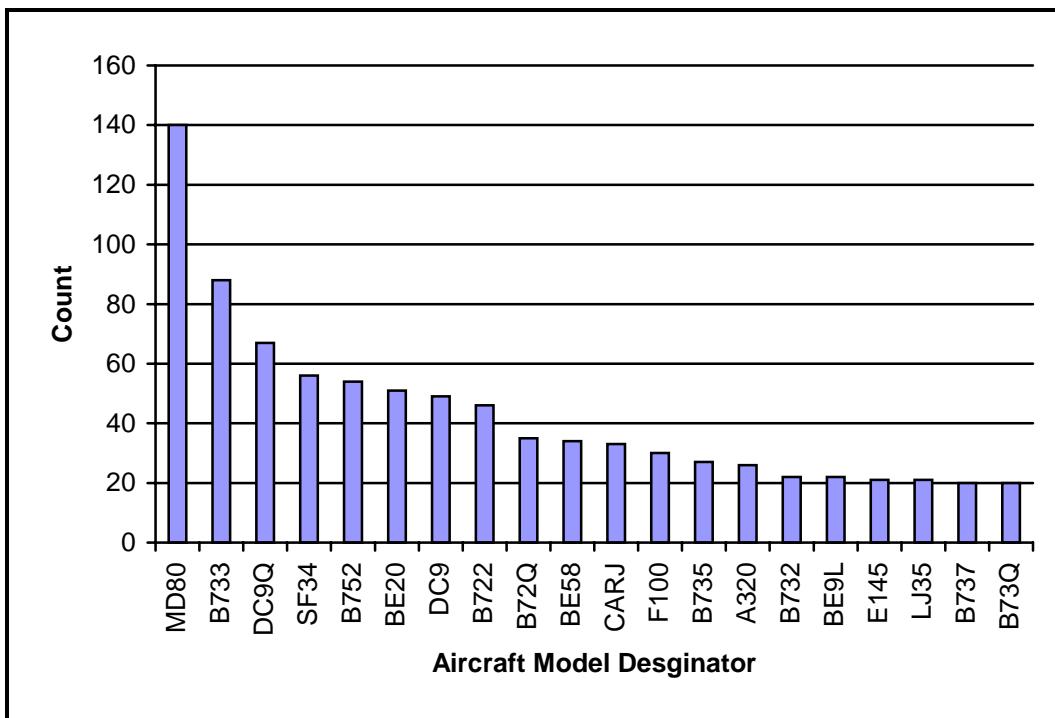


Figure 17: Count of Top Twenty Aircraft Models

7.3 Navigational Equipage

This section corresponds to Section 3.4.3 of Reference[1].

Table 16: Count by Aircraft Navigational Equipage Type

Nav. Equip. Designator	Count	Percentage of total
A	425	28.071
I	396	26.156
G	289	19.089
E	170	11.229
F	159	10.502
R	51	3.369
U	17	1.123
P	6	0.396
W	1	0.066
Total	1514	100.000

7.4 Carrier Distribution

This section corresponds to Section 3.4.4 of Reference[1].

Table 17: Count by Carrier Type

Category	Count	Percentage of Total
Commercial	929	61.361
General Aviation	538	35.535
Other ⁷	47	3.104
Total	1514	100.000

⁷ Includes military and aircraft with unrecognized designators

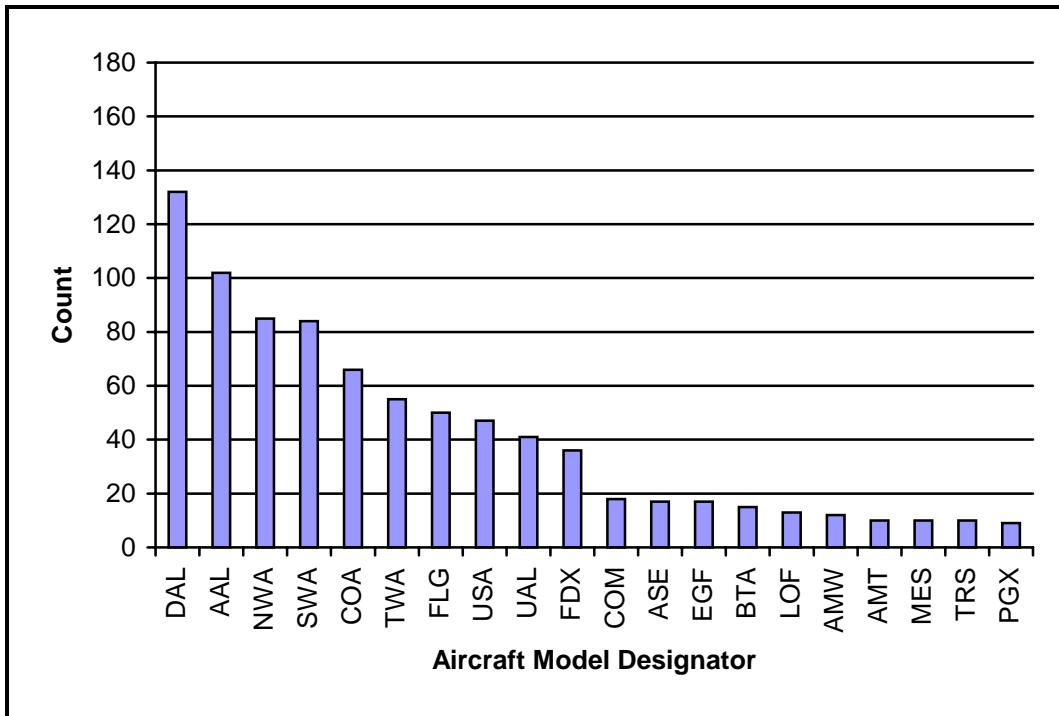


Figure 18: Count by Top Twenty Air Carriers

8 Flight Plan Adherence

This section provides statistics on lateral and vertical flight plan adherence and corresponds to Section 3.5 of Reference[1].

8.1 Lateral Flight Plan Adherence

This section corresponds to Section 3.5.1 of Reference[1].

Table 18: Statistics on Lateral Flight Plan Adherence by Altitude⁸

Upper Altitude (ft)	Flight Count	Max. Dist. Out (nm)	Min. Dist. Out (nm)	Average Dist. Out (nm)	Standard Dev.(nm)
10000	45	34	11	16.543	4.426
18000	31	34	13	18.748	3.505
33000	78	58	13	24.632	6.328
45000	39	40	15	22.341	3.429
Total	193				

8.2 Vertical Flight Plan Adherence

This section corresponds to Section 3.5.2 of Reference[1].

Table 19: Statistics on Vertical Flight Plan Adherence by Altitude⁹

Upper Altitude (ft)	Flight Count	Max. Dist. Out (ft)	Min. Dist. Out (ft)	Average Dist. Out (ft)	Standard Dev.(ft)
29000	660	31350	308	4117.207	3662.171
45000	250	25000	516	4724.708	3256.678
Total	910				

⁸ Statistics determined on tracks out of lateral adherence only.

⁹ Statistics were determined on tracks out of vertical adherence only.

9 Interfacility Traffic Flow

This section corresponds to Section 3.6 of Reference[1]. Table 20 duplicates Table 3.6-1 in reference and provides definitions for cells in Tables 21 and 22.

Table 20: Matrix of Traffic Sources in Scenario

Input - Flights into ZME		Output - Flights from ZME	
Starts in ZID		Ends in ZID	
Starts in ZME		Ends in ZME	
Starts in Other Center		Ends in Other Center	

Table 21: Statistics on Flights into ZME Airspace per minute

Input Flights	Average	Standard Deviation	Maximum Count	Minimum Count
From ZID	29.237	14.675	53	0
From ZME	60.683	28.864	110	0
From Other	89.650	41.454	144	0

Table 22: Statistics on Flights from ZME Airspace per minute

Output Flights	Average	Standard Deviation	Maximum Count	Minimum Count
To ZID	22.890	11.968	42	0
To ZME	55.897	22.775	94	0
To Other	100.783	53.009	173	0

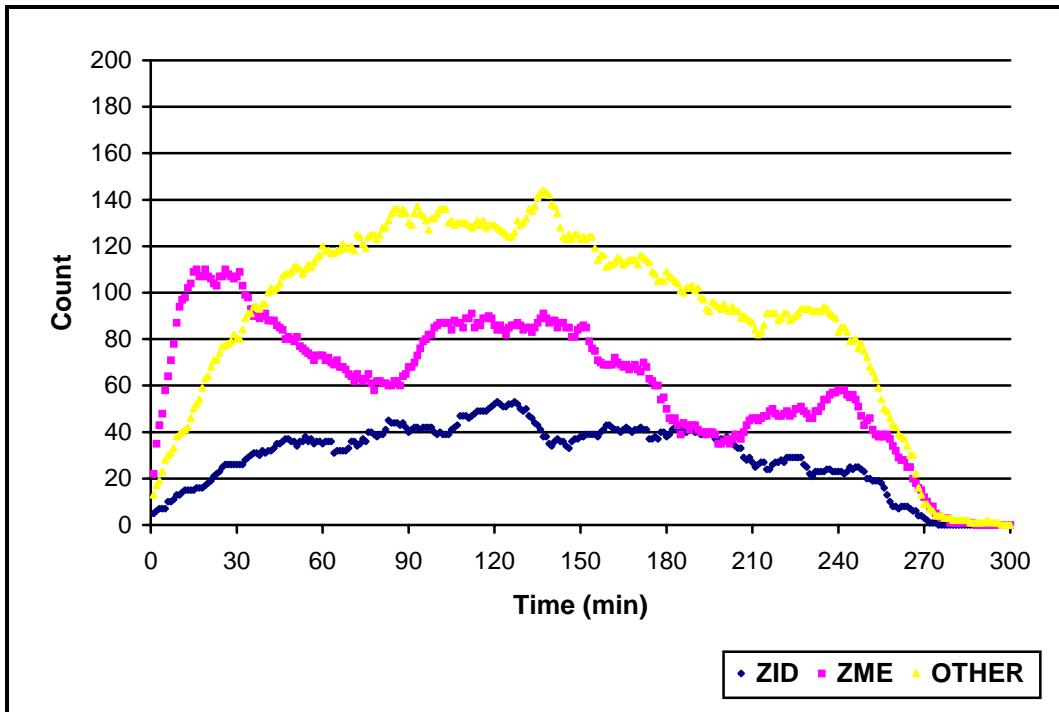


Figure 19: Flights into ZME from Legend Centers

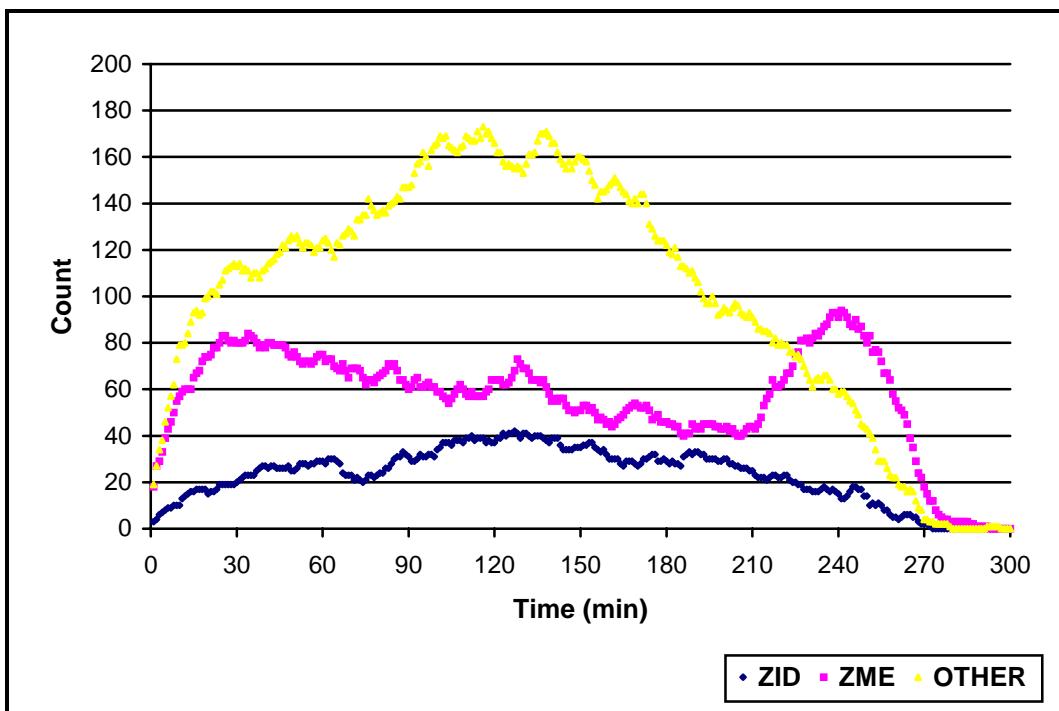


Figure 20: Flights from ZME to Legend Centers

10 Weather Variations

This section corresponds to Section 3.7 of Reference[1]. See the following document,

Kelly, Betty A., *User Request Evaluation Tool Core Capability Limited Deployment Accuracy Scenario Weather Forecast Deviation Study*, FAA William J. Hughes Technical Center / ACT-250, Atlantic City, New Jersey.

Appendix A: Supplement to Section 6.1 - Aircraft Traffic Density

Table 23: Statistics on Aircraft Encounters by Altitude Interval for All Hours

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	1	24.860	0.000
3000	6	15.446	8.565
4000	18	15.364	8.818
5000	18	18.517	6.227
6000	25	18.076	7.855
7000	19	20.043	7.550
8000	18	20.358	7.778
9000	15	19.176	8.136
10000	8	19.284	8.125
11000	13	15.202	9.075
12000	7	15.843	8.410
13000	14	16.268	7.059
14000	10	16.423	5.280
15000	9	20.542	6.879
16000	24	19.921	7.775
17000	39	17.508	8.112
18000	36	18.251	8.034
19000	25	20.224	7.583
20000	25	17.085	7.399
21000	20	16.157	7.878
22000	8	15.864	7.744
23000	13	18.626	6.429
24000	18	17.920	9.697
25000	26	18.838	7.784
26000	13	15.421	8.424
27000	17	13.620	8.831
28000	65	16.376	7.610
29000	93	16.265	8.446
31000	226	17.176	7.910
33000	268	16.082	8.220
35000	234	15.562	7.984
37000	86	15.107	8.291
39000	30	15.429	7.898
41000	14	16.115	9.770
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	1461		

Table 24: Statistics on Aircraft Encounters by Altitude for Hour 1

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	3	10.952	8.939
4000	6	13.536	10.683
5000	8	17.228	7.231
6000	4	15.655	5.448
7000	7	23.413	4.597
8000	6	15.847	8.880
9000	5	19.527	8.278
10000	4	20.412	5.488
11000	8	10.440	7.891
12000	3	15.776	8.096
13000	3	16.706	10.075
14000	4	17.540	6.543
15000	2	23.294	1.981
16000	2	25.251	0.189
17000	9	17.296	9.649
18000	8	16.629	8.292
19000	10	20.875	7.270
20000	10	18.129	6.192
21000	6	14.577	7.800
22000	1	3.548	0.000
23000	4	16.808	3.405
24000	4	12.477	13.674
25000	10	18.489	8.306
26000	4	12.567	9.685
27000	6	12.471	7.550
28000	13	16.213	9.391
29000	11	16.021	7.942
31000	24	15.788	7.768
33000	72	15.527	7.924
35000	64	14.307	8.304
37000	17	13.968	7.500
39000	8	15.979	8.365
41000	5	16.439	11.317
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	351		

Table 25: Statistics on Aircraft Encounters by Altitude for Hour 2

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	1	24.860	0.000
3000	0	0.000	0.000
4000	3	8.639	9.498
5000	2	23.677	3.804
6000	9	18.731	7.513
7000	6	14.227	8.374
8000	3	15.989	5.290
9000	4	14.634	9.193
10000	1	28.611	0.000
11000	2	24.435	5.217
12000	2	7.424	2.514
13000	2	24.919	3.258
14000	2	19.625	1.122
15000	3	20.341	6.444
16000	10	18.891	8.584
17000	15	18.077	8.409
18000	13	19.123	8.491
19000	6	18.003	10.012
20000	3	19.696	5.608
21000	3	16.931	10.876
22000	2	22.833	4.137
23000	3	19.754	5.771
24000	3	25.483	3.594
25000	5	16.229	9.403
26000	5	11.871	6.739
27000	5	13.654	10.514
28000	17	14.809	6.874
29000	28	17.587	7.926
31000	88	18.136	7.939
33000	75	16.734	8.584
35000	86	15.124	7.685
37000	30	18.452	7.581
39000	12	16.305	9.525
41000	1	21.170	0.000
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	450		

Table 26: Statistics on Aircraft Encounters by Altitude for Hour 3

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	3	19.941	6.547
4000	5	21.404	6.400
5000	8	18.517	5.504
6000	5	20.811	10.053
7000	3	21.734	9.905
8000	4	23.406	6.533
9000	1	20.387	0.000
10000	2	19.307	9.322
11000	1	24.568	0.000
12000	0	0.000	0.000
13000	5	13.440	5.217
14000	3	13.503	5.731
15000	2	12.974	10.087
16000	8	20.818	5.036
17000	12	17.310	5.877
18000	5	23.936	4.108
19000	6	18.175	6.446
20000	8	18.535	7.680
21000	7	19.879	7.499
22000	2	21.423	4.674
23000	4	18.747	11.083
24000	8	14.956	8.120
25000	7	19.472	8.500
26000	1	21.775	0.000
27000	2	20.836	10.956
28000	27	17.548	7.565
29000	31	14.207	8.921
31000	85	16.701	7.932
33000	75	16.063	7.780
35000	61	17.062	7.863
37000	28	12.297	8.313
39000	6	14.942	5.448
41000	6	14.966	11.717
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	431		

Table 27: Statistics on Aircraft Encounters by Altitude for Hour 4

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	1	12.048	0.000
5000	0	0.000	0.000
6000	7	16.662	8.731
7000	1	17.627	0.000
8000	1	29.705	0.000
9000	3	18.845	9.542
10000	0	0.000	0.000
11000	1	24.388	0.000
12000	2	24.363	0.078
13000	2	15.584	3.558
14000	1	14.310	0.000
15000	1	27.609	0.000
16000	1	1.421	0.000
17000	2	11.438	15.645
18000	7	15.178	8.814
19000	2	26.572	3.789
20000	3	12.563	7.669
21000	4	11.432	5.715
22000	3	11.618	2.840
23000	2	20.331	1.757
24000	3	25.518	2.885
25000	3	23.181	2.352
26000	3	23.026	6.285
27000	4	11.692	9.549
28000	6	17.685	6.534
29000	19	16.683	8.592
31000	25	17.924	7.529
33000	39	15.616	8.405
35000	22	16.235	8.091
37000	11	14.895	9.120
39000	3	9.687	4.086
41000	0	0.000	0.000
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	182		

Table 28: Statistics on Aircraft Encounters by Altitude for Hour 5

Upper Altitude (ft)	Aircraft Count	Avg. Horz. Sep.(nm)	Standard Dev.(nm)
1000	0	0.000	0.000
2000	0	0.000	0.000
3000	0	0.000	0.000
4000	3	16.781	5.095
5000	0	0.000	0.000
6000	0	0.000	0.000
7000	2	24.370	4.258
8000	4	25.019	4.447
9000	2	27.275	0.922
10000	1	5.400	0.000
11000	1	16.279	0.000
12000	0	0.000	0.000
13000	2	14.716	10.797
14000	0	0.000	0.000
15000	1	23.713	0.000
16000	3	23.576	6.831
17000	1	25.383	0.000
18000	3	16.491	7.445
19000	1	26.647	0.000
20000	1	0.777	0.000
21000	0	0.000	0.000
22000	0	0.000	0.000
23000	0	0.000	0.000
24000	0	0.000	0.000
25000	1	17.904	0.000
26000	0	0.000	0.000
27000	0	0.000	0.000
28000	2	10.996	6.555
29000	4	21.635	8.550
31000	4	9.796	7.788
33000	7	17.620	12.171
35000	1	27.299	0.000
37000	0	0.000	0.000
39000	1	20.666	0.000
41000	2	16.221	2.850
43000	0	0.000	0.000
45000	0	0.000	0.000
Total	47		

Appendix B: Supplement to Section 6.4 - Aircraft Ground Speed

Table 29: Statistics on Ground Speed by Altitude for All Hours

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	22	146.660	33.018
2000	124	173.839	46.687
3000	317	185.688	53.079
4000	457	181.713	46.837
5000	530	184.606	52.419
6000	556	180.692	47.831
7000	597	196.366	48.819
8000	667	196.485	49.597
9000	669	202.560	56.333
10000	661	238.106	73.788
11000	649	245.990	73.156
12000	635	262.950	72.823
13000	627	267.485	69.756
14000	622	267.462	73.799
15000	623	275.102	73.444
16000	612	273.780	73.331
17000	604	279.001	69.440
18000	582	281.140	84.794
19000	561	295.995	81.984
20000	535	304.944	83.249
21000	509	328.170	71.804
22000	493	337.115	86.713
23000	487	368.876	81.243
24000	481	367.756	83.038
25000	493	373.058	84.343
26000	498	371.107	92.884
27000	500	403.280	82.613
28000	517	419.520	56.867
29000	509	455.427	63.091
31000	513	417.005	42.280
33000	454	470.301	42.329
35000	329	400.294	39.014
37000	214	468.025	53.485
39000	127	399.061	53.753
41000	76	451.402	60.151
43000	33	432.832	49.160
45000	8	426.276	43.081

Table 30: Statistics on Ground Speed by Altitude for Hour 1

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	8	137.279	36.666
2000	29	178.830	51.864
3000	83	186.736	53.639
4000	130	175.003	46.708
5000	146	177.277	48.790
6000	153	192.996	50.902
7000	169	200.712	50.653
8000	197	205.501	46.708
9000	190	206.024	57.375
10000	186	242.525	65.932
11000	179	270.449	68.645
12000	174	265.118	69.285
13000	176	255.162	69.125
14000	173	256.125	74.702
15000	175	276.874	75.333
16000	176	284.565	74.227
17000	176	304.088	70.375
18000	166	275.467	75.334
19000	161	295.412	76.907
20000	153	300.934	83.582
21000	142	327.412	84.894
22000	139	333.873	83.257
23000	132	386.277	70.889
24000	127	341.132	89.374
25000	125	360.799	79.031
26000	125	369.769	89.315
27000	125	396.746	90.712
28000	129	420.506	42.956
29000	122	428.762	68.995
31000	133	423.265	48.870
33000	131	466.220	43.652
35000	104	398.062	34.986
37000	59	464.519	46.785
39000	33	396.640	39.263
41000	18	393.707	73.020
43000	11	430.561	52.329
45000	3	398.055	23.645

Table 31: Statistics on Ground Speed by Altitude for Hour 2

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	6	164.636	35.707
2000	32	164.296	45.666
3000	82	189.580	56.493
4000	133	184.611	49.187
5000	161	182.073	50.562
6000	165	185.584	45.041
7000	173	196.488	41.358
8000	190	198.297	52.410
9000	198	208.530	53.587
10000	191	267.824	70.540
11000	184	250.212	62.656
12000	179	268.773	66.580
13000	177	267.765	64.608
14000	179	274.565	69.510
15000	177	281.308	61.151
16000	175	277.545	68.708
17000	167	271.591	62.222
18000	156	300.857	75.696
19000	150	279.219	81.244
20000	150	299.466	76.631
21000	140	352.653	73.368
22000	138	361.418	78.677
23000	131	377.997	67.625
24000	136	366.326	80.665
25000	139	357.807	88.274
26000	138	356.211	99.318
27000	129	406.591	78.650
28000	133	391.022	82.704
29000	146	459.585	55.398
31000	155	415.597	38.613
33000	143	468.493	42.715
35000	124	402.944	30.936
37000	81	464.021	49.899
39000	47	405.021	44.395
41000	26	447.851	54.752
43000	7	417.318	37.307
45000	3	448.780	40.402
Total	6	164.636	35.707

Table 32: Statistics on Ground Speed by Altitude for Hour 3

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	4	143.778	17.702
2000	30	177.940	49.598
3000	84	180.779	50.726
4000	104	183.340	41.846
5000	128	193.286	51.071
6000	138	175.610	45.220
7000	139	201.854	49.974
8000	148	205.197	46.323
9000	152	199.292	59.901
10000	157	234.072	73.204
11000	154	261.454	70.659
12000	153	256.911	71.239
13000	148	271.496	63.885
14000	145	262.459	67.378
15000	146	272.429	69.987
16000	140	258.167	66.769
17000	144	275.319	65.585
18000	137	263.554	93.639
19000	131	285.554	74.283
20000	127	315.444	79.553
21000	122	313.487	57.325
22000	120	305.152	87.194
23000	121	342.095	82.623
24000	127	367.628	81.141
25000	137	386.258	75.628
26000	146	382.921	82.918
27000	148	399.273	71.393
28000	162	423.749	41.966
29000	162	448.329	71.042
31000	166	415.198	38.672
33000	119	470.636	45.759
35000	97	398.578	41.238
37000	65	475.973	45.996
39000	46	413.576	50.278
41000	27	465.042	49.450
43000	6	394.234	48.319
45000	1	498.035	9.264

Table 33: Statistics on Ground Speed by Altitude for Hour 4

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	2	170.000	22.546
2000	26	175.444	41.858
3000	67	184.667	52.304
4000	91	183.944	46.397
5000	103	185.984	58.458
6000	116	172.883	49.109
7000	119	186.920	49.731
8000	127	183.186	48.325
9000	128	202.871	56.410
10000	124	229.342	78.385
11000	116	221.055	78.263
12000	116	280.759	80.851
13000	114	292.287	82.518
14000	113	297.220	82.751
15000	110	303.874	85.339
16000	110	285.440	81.523
17000	104	276.353	74.647
18000	105	303.190	85.896
19000	109	357.782	75.060
20000	98	310.895	91.769
21000	100	328.119	62.958
22000	96	349.826	86.601
23000	98	374.990	89.827
24000	96	386.422	77.877
25000	96	385.715	94.444
26000	94	367.324	104.165
27000	102	403.897	89.064
28000	107	443.405	39.672
29000	111	464.376	56.865
31000	111	415.953	48.099
33000	107	474.915	38.130
35000	73	400.022	50.887
37000	46	472.407	62.900
39000	29	370.391	72.871
41000	19	483.147	29.802
43000	6	458.344	34.925
45000	1	409.515	2.637

Table 34: Statistics on Ground Speed by Altitude for Hour 5

Upper Altitude (ft)	Distinct Aircraft	Average Speed (kts)	Standard Dev.(kts)
1000	1	134.125	5.222
2000	9	178.603	33.491
3000	27	194.870	49.681
4000	38	191.865	53.573
5000	37	193.132	62.677
6000	45	168.286	47.474
7000	54	193.829	58.226
8000	54	177.287	48.560
9000	53	184.076	48.554
10000	53	203.450	67.915
11000	53	227.407	74.622
12000	44	226.237	71.790
13000	45	252.561	69.849
14000	44	260.715	78.335
15000	46	235.022	74.617
16000	50	254.968	75.563
17000	52	267.741	88.208
18000	49	258.114	91.809
19000	44	285.701	86.407
20000	36	300.766	94.216
21000	32	351.899	108.410
22000	29	393.088	56.075
23000	31	369.925	64.300
24000	31	408.489	54.250
25000	38	355.466	74.607
26000	36	407.469	72.669
27000	39	435.019	67.806
28000	39	400.972	77.692
29000	40	484.222	39.745
31000	41	427.188	40.841
33000	36	478.871	30.619
35000	25	406.262	48.050
37000	21	446.948	81.842
39000	14	410.165	62.727
41000	12	469.865	31.760
43000	7	469.103	23.478
45000	2	444.568	12.005

Appendix C: Supplement to Section 6.8 - Air Traffic Maneuvers

Table 35: Count of Maneuvers by Altitude, Vertical and Horizontal Phase of Flight

Upper Altitude (ft)	Vertical Phase	Horizontal Phase of Flight	
		STR	TURN
1000	ASC	13	13
	DES	1	3
	LEV	6	16
2000	ASC	34	40
	DES	41	16
	LEV	47	56
3000	ASC	126	145
	DES	102	95
	LEV	157	139
4000	ASC	129	112
	DES	148	133
	LEV	265	151
5000	ASC	132	75
	DES	168	104
	LEV	330	128
6000	ASC	130	89
	DES	199	103
	LEV	353	100
7000	ASC	126	71
	DES	232	97
	LEV	354	87
8000	ASC	91	48
	DES	328	166
	LEV	344	61
9000	ASC	61	35
	DES	327	195
	LEV	334	59
10000	ASC	133	56
	DES	332	149
	LEV	338	78
11000	ASC	80	26
	DES	357	86
	LEV	336	63
12000	ASC	58	20
	DES	356	52
	LEV	331	36
13000	ASC	36	11
	DES	351	42
	LEV	329	27

14000	ASC	33	14
	DES	351	36
	LEV	332	36
15000	ASC	46	25
	DES	351	27
	LEV	331	34
16000	ASC	58	27
	DES	339	23
	LEV	330	35
17000	ASC	54	29
	DES	333	25
	LEV	323	27
18000	ASC	38	18
	DES	313	22
	LEV	312	33
19000	ASC	46	21
	DES	310	18
	LEV	313	28
20000	ASC	45	21
	DES	288	15
	LEV	289	32
21000	ASC	38	14
	DES	274	13
	LEV	284	29
22000	ASC	40	22
	DES	261	21
	LEV	262	30
23000	ASC	43	18
	DES	264	16
	LEV	260	42
24000	ASC	65	36
	DES	256	25
	LEV	247	38
25000	ASC	52	26
	DES	253	28
	LEV	270	49
26000	ASC	49	22
	DES	259	27
	LEV	277	49
27000	ASC	77	39
	DES	264	30
	LEV	278	52
28000	ASC	174	102
	DES	256	39

	LEV	290	61
29000	ASC	176	93
	DES	255	33
	LEV	288	46
31000	ASC	228	122
	DES	256	42
	LEV	301	56
33000	ASC	265	169
	DES	217	50
	LEV	242	39
35000	ASC	226	150
	DES	139	26
	LEV	155	34
37000	ASC	147	100
	DES	97	25
	LEV	91	20
39000	ASC	95	54
	DES	65	6
	LEV	44	9
41000	ASC	67	43
	DES	40	11
	LEV	33	8
43000	ASC	29	16
	DES	13	4
	LEV	11	2
45000	ASC	8	5
	DES	3	1
	LEV	3	1

Appendix D: Supplement to Section 7.2 - Aircraft Models

Table 36: Count and Percentage of Aircraft by Model Type

Model Type	Aircraft Count	Percent of Total
MD80	140	9.247
B733	88	5.812
DC9Q	67	4.425
SF34	56	3.699
B752	54	3.567
BE20	51	3.369
DC9	49	3.236
B722	46	3.038
B72Q	35	2.312
BE58	34	2.246
CARJ	33	2.180
F100	30	1.982
B735	27	1.783
A320	26	1.717
B732	22	1.453
BE9L	22	1.453
E145	21	1.387
LJ35	21	1.387
B737	20	1.321
B73Q	20	1.321
C560	19	1.255
C550	17	1.123
C650	17	1.123
PA31	17	1.123
A306	16	1.057
B190	16	1.057
H25B	16	1.057
DC10	14	0.925
B763	13	0.859
BE36	13	0.859
C210	13	0.859
E120	13	0.859
B734	12	0.793
BE40	12	0.793
C421	12	0.793
C130	11	0.727
LJ31	11	0.727
BA46	10	0.661
BE55	9	0.594

LJ24	8	0.528
AC90	7	0.462
C310	7	0.462
C501	7	0.462
FA10	7	0.462
FA20	7	0.462
MU2	7	0.462
C441	6	0.396
GLF2	6	0.396
LJ55	6	0.396
PA32	6	0.396
PAY2	6	0.396
PC12	6	0.396
B727	5	0.330
BE33	5	0.330
BE35	5	0.330
BE90	5	0.330
C340	5	0.330
C500	5	0.330
C525	5	0.330
FA50	5	0.330
HS25	5	0.330
LJ25	5	0.330
M20	5	0.330
SBR1	5	0.330
WW24	5	0.330
AEST	4	0.264
AT45	4	0.264
AT72	4	0.264
B762	4	0.264
C414	4	0.264
H25A	4	0.264
LJ60	4	0.264
P32R	4	0.264
PA34	4	0.264
PA46	4	0.264
PAY1	4	0.264
A310	3	0.198
AC95	3	0.198
ASTR	3	0.198
BE10	3	0.198
BE18	3	0.198
DC87	3	0.198
H60	3	0.198
L101	3	0.198

LR25	3	0.198
LR35	3	0.198
P28R	3	0.198
PA27	3	0.198
SW3	3	0.198
SW4	3	0.198
AC50	2	0.132
AC6T	2	0.132
BE9T	2	0.132
C141	2	0.132
C208	2	0.132
DC86	2	0.132
DC8Q	2	0.132
F2TH	2	0.132
F900	2	0.132
GLF3	2	0.132
GLF5	2	0.132
H25C	2	0.132
JS31	2	0.132
LJ23	2	0.132
M20T	2	0.132
MD11	2	0.132
MD90	2	0.132
MU2B	2	0.132
P210	2	0.132
P28A	2	0.132
P3	2	0.132
PA28	2	0.132
SH33	2	0.132
SW2	2	0.132
T2	2	0.132
T37	2	0.132
T38	2	0.132
A10	1	0.066
A300	1	0.066
AC11	1	0.066
AT38	1	0.066
AT43	1	0.066
B350	1	0.066
B52	1	0.066
B55	1	0.066
B721	1	0.066
B738	1	0.066
B73B	1	0.066
B742	1	0.066

BE60	1	0.066
BE65	1	0.066
BE76	1	0.066
BE95	1	0.066
BL17	1	0.066
C17	1	0.066
C172	1	0.066
C177	1	0.066
C180	1	0.066
C335	1	0.066
C401	1	0.066
C402	1	0.066
C425	1	0.066
C750	1	0.066
CL41	1	0.066
CL65	1	0.066
DA20	1	0.066
DC8	1	0.066
DC85	1	0.066
F16	1	0.066
G2	1	0.066
G4	1	0.066
GC1	1	0.066
KR35	1	0.066
L329	1	0.066
LJ45	1	0.066
M20P	1	0.066
MO20	1	0.066
MU30	1	0.066
MXT7	1	0.066
P180	1	0.066
P28B	1	0.066
P31T	1	0.066
PA23	1	0.066
PA24	1	0.066
PAY3	1	0.066
TRIN	1	0.066
Total	1514	100.000